LAND USE IMPLICATIONS OF SURFACE WATER ALLOCATION

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INSTITUTE OF GOVERNMENT
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A final report in this series is also planned for publication during 1966, and possibly one other Paper.

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FOREWORD

This paper is based on a master's thesis in regional planning which Vernon George completed in early 1965.* It is one of a series of monographs emanating from a four-year research program concerning water use in North Carolina, a program undertaken in 1962 by the Institute of Government with the aid of a grant from the United States Public Health Service. Previous papers in the series have been concerned with surveys of irrigation, industrial water use and public water supplies. This paper initiates a more analytical phase which will bring to bear the tools of economics, planning, hydrology and geology in evaluating existing water use arrangements.

If the tone of this monograph seems theoretical, this is not by accident. Its objective is to survey those legal and institutional arrangements respecting water use which may broadly be labelled "allocation" techniques, and to systematically explore their potential land use implications. This leaves an open field for further empirical studies on the subject. We believe that such studies will prove to be well worth pursuing and hope that other planners will pick up where this effort leaves off.**

I would summarize the message of this monograph in four points.

(1) Some scheme of "allocation" is necessary today in order to satisfactorily distribute water resources among competing users. Even in the humid areas of the United States, available water resources are becoming inadequate to meet all demands at all times in our urbanizing economy.

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*In partial fulfillment of the requirements for the degree of Master of Regional Planning in the Department of City and Regional Planning, University of North Carolina at Chapel Hill.

**George's original thesis is about twice the length of this paper. A chapter concerning the technical or physical aspects of water use has been omitted, and the chapter concerning allocation techniques has been somewhat shortened. Also omitted is a chapter containing case studies on the Roanoke River Basin and the Research Triangle Region. These editorial cuts are designed to sharpen the focus on the heart of George's original thesis, that is, his survey of water allocation alternatives and their hypothetical land use implications.

(2) In the broad sense used in this monograph, there are two traditional allocation systems in the United States which control the basic right to use water: riparian rights in the East and prior appropriation in the West.

Two additional allocation techniques have been evolved more recently, in the field of water quality management: stream classification and stream specialization. (Stream classification is a technique used by a number of states in administering their water pollution control programs. This technique permits these states to make distinctions between criteria governing water use under varying conditions on different segments of a river basin. "Stream specialization," as George terms it, is the assigning of different functions to parallel streams within a developed region in order to make most effective use of regional water resources.)

Finally there are, at least in theory, two other important methods of allocation: the laissez faire approach of relying exclusively upon the market to allocate water use, and a modification of market allocation in which the market is guided and supplemented by a public agency attempting to maximize the public interest. George refers to the former as "unregulated market control," and to the latter as "public market intervention" or the "regulated market."

Although each of these allocation techniques may be logically distinguishable from one another, they are not mutually exclusive even in logic, and they are often actually applied in combination. In North Carolina, for example, we have a mixture of a liberalized riparian rights doctrine and stream classification.

(3) The land use implications of these six methods of water allocation can be described in terms of their effects on four factors familiar to land use planners. These are the density of development; the physical form or shape of development (such as a linear pattern); the composition of land use patterns (whether homogeneous or heterogeneous); and the composition of social class (whether homogeneously or heterogeneously arrayed).

Viewed in these terms, the hypotehtical land use implications of water allocation cover a broad spectrum. For example, George reasons, strict riparian water rights doctrine would be likely to result in high

density, linear development with a tendency to heterogeneous use. (The liberalized riparian doctrine currently applied in most eastern jurisdictions has no such straightforward land use implications.) By contrast, stream classification would tend toward homogeneous use classification with cluster-shaped development, while the land use implications of public market intervention are quite unpredictable.

(4) Although some parts of this paper will be familiar terrain to many readers, other sections--especially the chapter on land use implications--break new ground. Special attention should also be called to George's discussion of the regulated market and of the steps taken by the Federal Power Commission in the direction of imposing user charges for diversions from FPC-licensed reservoir projects which reduce the power generating capacity of the projects. (See pages 17-23.)

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It should be only a short step from the implications of water allocation for land use to its implications for land use planners. The most obvious lesson to be drawn from George's analysis is that planners ought to devote more attention than has been their custom to water allocation matters. Why? Simply because, as George points out, the allocation alternatives can produce such a wide range of land use effects, some of which may be much preferable to others. This is doubly so because the general run of experience with water allocation matters suggests that allocation choices, once made, tend to be quite rigid and difficult to disturb.

To this observer it seems most obvious, therefore, that planners should give high priority to developing strategies for identifying and exploiting favorable allocation alternatives in a variety of settings. As a prerequisite to this, some elaboration and refinement of George's analysis may be necessary. For example, empirical studies are needed on the workings of actual water allocation models (as distinguished from the theoretical models analyzed by George). In addition further studies are needed on the implications of water allocation devices in the context of other land use determinants, such as transportation facilities.

I would also urge that planners should miss no opportunities to make their contribution to evaluating actual allocation proposals before action

is taken, such as new or changed stream classifications and important changes in water rights law. Too often in the past the voice of the planner has been heard only in criticism of past decisions, too late for a positive contribution. The field of water resource conservation and development is in a state of ferment unparalleled in American history. Unless the planning profession moves promptly into high gear, important and practically irreversible water allocation decisions will be made before planners are ready to make their contribution to the decision making process.

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Vernon George joins me in thanking my secretary, Willie Mae Haizelip, for her patient and valued labors in typing and improving both the thesis and monograph manuscripts. By now she is at least twice as familiar with water allocation theory as either of us.

Milton S. Heath, Jr.
Assistant Director
Institute of Government

CHAPTER I

INTRODUCTION

The general problem

Water is among the most valuable of our natural resources. All animals must take in small quantities of it daily in order to satisfy their physiological needs--man needs approximately a gallon a day. Water is also essential to the production-oriented activities which stand as a basis for our economy, and provide the goods which fulfill our needs and determine our standard of living. In addition to its part in our physiological and economic existence, water contributes much to our enjoyment of life through the important part it plays in recreation and the aesthetic beauty of nature.

North America is particularly fortunate in terms of fresh water supply. In fact, so fortunate that a recent study predicted that the water resource potential in the United States is more than sufficient to meet demands through the year 2000.[1] In addition to an adequate _total_ quantity, the continually improving technology of our contemporary society makes higher quality and more dependable quantities of water available. It might seem, then, that there is no particular water problem. And yet, hardly a year goes by when farmers in some part of our country are not faced with loss of a major part of total crop value due to drought. Each summer lakes and rivers must be posted against swimming because of pollution caused by inadequate sewage treatment. Many small communities face totally inadequate supplies during periods of low flow, and rapidly growing, larger urban areas fear immediate limitation on further expansion because of short water supplies.[2] Widespread drought conditions can be disastrous for water users even in our humid regions, as the extended

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[1] U.S. Senate Select Committee on National Water Resources, 86th Congress, "Water Supply and Demand," Committee Print Number 32 (August, 1960), p. 126.

[2] U.S. Senate Select Committee on National Water Resources, 86th Congress, "Views and Comments of the States," Committee Print Number 6 (December, 1960).

northeast drought so vividly attests. Thus, it is clear that water resource shortages do exist and that some system is required to distribute the scarce resource among competing users. This study focuses on this problem of allocation.

Basic issues involved

There are four major considerations which influence water allocation: physical development, economic, political-administrative, and social.

The physical development of a water resource involves construction of facilities which will store the water in times of high flow in order that it might be released in periods of lower flow, the development of facilities for power generation, the development and implementation of treatment techniques required for desired quality levels, and the design and construction of transmission facilities which will allow the movement of the water from its point of natural supply to the area of demand. The physical development of the resource determines the quantity of the water resource which will be available for allocation. Technological advances in these areas help to meet temporal and spatial problems of inequality of supply with demand.

Economic aspects include the appraisal of the effects of various allocation techniques in comparison with the pattern of water use which would result from distribution of the resource by the law of supply and demand; the valuation of water uses such as recreation and human consumption in comparable economic terms, and the analysis of the economic effects of various allocation techniques upon established rights.

Political-administrative criteria can also be influential in determining the method of water allocation. Certain interest groups exist in every community, and those that are most powerful tend to exert a great degree of control over decisions which will affect their interests, such as those involving water allocation. In addition, it is essential that any technique adopted be administratively feasible--i.e., that it can be administered with available personnel and financial resources.

Social criteria are those that deal with the impact of the proposed allocation technique on the people of the community themselves. Allocation techniques should be evaluated in terms of whether they maximize public or social interests, as distinguished from individual interests.

Although these criteria are particularly difficult to measure, their importance is great.

This study focuses on the land use implications of the various water allocation techniques. These land use implications, in effect, cut across the total range of allocation issues: social, economic, physical, and political-administrative. Although land use effects have been given little attention in past allocation research, greater attention will be required in the future.

The purpose of this study, then, is twofold. First, to explore land use implications as a factor in allocation decisions by professional and political bodies, and second, to provide a firmer foundation for more detailed research in this area. Where local reference is needed, North Carolina water resource institutions furnish the setting.

Study approach

Chapter II will describe briefly the major existing types of allocation techniques, with elaborations on some of the less familiar models and on North Carolina law. Chapter III will seek to identify and evaluate the theoretical land use implications of the application of each of these techniques. The discussion will be structured around certain significant characteristics of land use. Some concluding observations are set forth in Chapter IV.

CHAPTER II

ALLOCATION TECHNIQUES

Allocation is defined by Webster as, "The Act of distributing; allotment or apportionment . . . of available materials."[1] The available material that is being discussed here is water resource use. This use can be through the withdrawal of water or as it remains in the watercourse. As the amount of water available is limited, a framework is required for determining the use pattern. Such a framework may be called an "allocation technique."

Allocation techniques, both existing and proposed, are based upon a wide range of criteria and administrative structures. These techniques range in degree of public control from the free market mechanism--where the only control is price determined in the market--to complete authority in allocation exerted by an administrative agency implementing legislatively determined policy.[2] The criteria range from maximizing public good to the ownership of land adjoining the stream.

The several techniques are not necessarily mutually exclusive. Some seek to bring greater rationality to allocation in the form of resource efficiency and public good, but without unduly infringing on the vested rights of current users. The resulting over-all allocation framework is often a compromise between two or more basic techniques. North Carolina is typical of states which have attempted to modernize their allocation framework with the minimum of harm to existing users.

The term "water allocation" has sometimes been equated narrowly with the water rights law prevailing in the western states. In this study, however, the term is used in its broadest sense to embrace all

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[1] Webster's New Collegiate Dictionary (Springfield, Mass: The G. & C. Merriam Co., 1960).

[2] Actual allocation legislation is primarily a legal matter with many lawyers specializing in its development and interpretation. The broad implications of allocation are clear, however, and a considerable amount of research has been done by other professions including: resource and urban economists, engineers, and those interested in the various aspects of public administration.

manner of legal and institutional arrangements which have the effect, directly or indirectly, of allocating the use of water.

Allocation techniques as defined in this study fall generally into three basic types, each composed of two major subtypes: existing or traditional water rights law, including the riparian and prior appropriation doctrines; classification, including the river basin and stream specialization or parallel rivers approaches; and the market, both the unregulated market, and public market intervention as a guide for control by a public agency. It is the purpose of this part of the study to discuss this spectrum range of allocation techniques.

In addition, the current system in North Carolina will be reviewed as an example of the overlay of one technique on another in order to adjust the original use pattern to meet changing needs.

Traditional Water Rights Laws

Water allocation by means of water rights law in the United States has been principally of two types: the riparian doctrine, which originated in the East and is still in existence in most of the states east of the Mississippi River; and the prior appropriation doctrine, which was developed in the West, inspired by the generally dryer climate in that portion of the country. The exact interpretation of both types varies greatly from state to state; thus, what follows is a composite description and does not attempt to present the law in any particular state.

Riparian doctrine

The doctrine of riparian rights forms the primary basis of the laws governing natural watercourses in most of the United States.

Early development.--This doctrine is thought to have been established in the Civil Law, by the Code Napoleon in 1804.[3] Elements of

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[3]Harold H. Ellis, "Development and Elements of the Riparian Doctrine with Reference to the Eastern States," Papers delivered at the Water Rights Conference 1960 (East Lansing: College of Agriculture, Michigan State University, 1960), p. 19.

the doctrine were present in early English and Roman law also.[4] The principal development of the riparian doctrine in the United States seems to have originated with two early American jurists, Story and Kent.[5]

Basic criteria.--The strict riparian doctrine, in general, provides that the owners of lands which adjoin a watercourse hold certain rights to the use of its waters, which strictly interpreted, include the right to have the stream flow past their property substantially undiminished in quantity and quality.[6] These are rights of use, not ownership of the flowing waters, but they are ordinarily regarded as rights entitled to legal protection.[7]

The riparian owner has primary right to use the water in, or take the water from, the watercourse for use on his adjoining land (and only his adjoining land) for "domestic" or other natural purposes.[8] These purposes include use for family drinking water and other household needs, and it is generally held that each riparian owner, in turn going downstream, may use all the available water he needs for such purposes even if he exhausts the entire flow.[9]

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[4]Theodore E. Lauer, "The Riparian Right as Property," Water Resources and the Law (Ann Arbor: University of Michigan Law School, 1958).

[5]S. C. Wiel, Origin and Comparative Development of the Law of Watercourses in the Common Law and in the Civil Law, California Law Review (1918), pp. 247-48.

[6]Jack Hirshleifer, James C. De Haven, and Jerome W. Milliman, Water Supply: Economics, Technology and Policy (Chicago: University of Chicago Press, 1960), p. 232.

[7]Lauer, pp. 259-65.

[8]Wells A. Hutchins and Harry A. Steele, "Basic Water Rights Doctrines and Their Implications for River Basin Development," Law and Contemporary Problems (Durham, N. C.: Duke University, Spring 1957), II, No. 2, p. 279.

[9]Arthur M. Piper and Harold E. Thomas, "Hydrology and Water Law: What Is Their Future Common Ground," Water Resources and the Law (Ann Arbor: University of Michigan Law School, 1958), pp. 15-16.

All non-domestic uses are termed "artificial."[10] This includes irrigation, industrial and general municipal use. Non-domestic uses are regulated by one of two doctrines. The "natural flow" doctrine permits a riparian owner to take water for artificial purposes as long as the use does not substantially diminish the quantity or quality of the natural flow essential to downstream riparian users.[11] As strict interpretation of this phrase would preclude most use, courts have shifted position to allow the riparian owner to make "reasonable" riparian use of the stream.[12]

The more liberal "reasonable" concept permits a riparian owner to take water for artificial purposes so long as the courts consider the use consistent with the rights of other riparians.[13] Typical criteria for determining the reasonableness of a use are: size and character of the watercourse; the location and type of use; the amount of water withdrawn and returned (net consumption); the rights and reasonable requirements of other riparian owners; and issues of general public welfare.

Courts have held that under riparian doctrine the fact that one person began his use before another does not in itself determine or substantially affect their respective rights.[14] A riparian owner does not lose his water rights by failing to exercise them through not using the water. This feature of the law may limit the horizons of potential change in allocation techniques.

Two special applications may alter the results that would normally follow under riparian principles. The first is "prescription" whereby

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[10]Robert Marquis, Richard Freeman, and Milton S. Heath, Jr., The Movement for New Water Rights Laws in the Tennessee Valley States (Reprint from Tennessee Law Review, 1955), 23, No. 7.

[11]Ellis, pp. 21-22.

[12]This interpretation was first clearly set down by Justice Story in the Federal circuit court case of Tyler v. Wilkinson, 4 Mason 400 (1827).

[13]Lauer, p. 279.

[14]Lauer, p. 286.

the riparian or non-riparian gains permanent right to use a quantity of water through adverse possession, consisting of open use over the statutory period (usually twenty years).[15] The second is the "Balance of Convenience Doctrine," whereby the court may decide that although riparian rights have been illegally taken, the violating user is of sufficient value to the community that while damages will be awarded, an injunction will not be granted.[16]

Prior appropriation

While riparian law prevailed in the east, the relatively greater scarcity of water in the west increased the potential for conflict. As a result, a technique was adopted which made it possible to obtain a right for a specific quantity of water rather than the indefinite riparian criteria of "reasonable use."

Early development.--The doctrine of prior appropriation was developed in response to this need by the Spanish in the Southwest and the Mormons in Utah, in the late 1840's.[17] During the gold rush days in California, a miner not only staked a claim to the right to mine gold from a specific area, but also obtained the legal right to the specific quantity of water required to work it.[18] This doctrine makes the right to water use dependent upon the application of a previously unappropriated quantity of water to a beneficial use.[19]

The rights of the various appropriators are dependent upon time, when determining priority. In keeping with the traditional "first in time, first in right" concept, an appropriator has right to water use

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[15] Piper and Thomas, p. 17.

[16] Ellis, p. 25.

[17] Barlowe, pp. 356-59.

[18] Marquis, Freeman, and Heath, p. 24.

[19] Haber and Bergan (ed.), The Law of Water Allocation in the Eastern United States (Washington: Symposium, U. S. Government Printing Office, 1956), p. 4.

only after the rights of those who filed their right before him have been filled.[20] This means that an appropriator, if he can determine the water rights of prior appropriators and can compare it against the annual pattern of stream flow, may determine when and in what quantities water is likely to be available to him. He can also evaluate the benefit that he would derive from physical development which would increase stream flow.[21]

In contrast with riparianism, appropriation doctrine places no general restriction on the land on which water may be used.[22] The doctrine, rather, makes all rights conditional upon continued application to a beneficial use. A lapsing of the use, or an unauthorized switch to another use, results in a forfeiture of the right.[23] An appropriation permit is quite specific in that an individual may acquire a right to divert a given quantity of water, at given times and from a given point of diversion, for use for a given purpose.[24]

Most states have established an order of use preference which they use as a basis for choosing among applications considered at a particular time.[25] Because farming came first in the development of the West, rights to much of the available dependable flow are held by agricultural interests. Once a right has been established, it can only be rescinded upon payment of compensation.[26]

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[20]Piper and Thomas, p. 19.

[21]Thus an appropriator could also be charged a part of the cost of an improvement--such as a storage reservoir--which would adjust the flow pattern consistent with his interests. Such a form of "user charge" is felt by many to be more equitable than financing through a general taxation.

[22]Lauer, p. 283.

[23]Piper and Thomas, pp. 19-21.

[24]Hirshleifer, De Haven, and Milliman, p. 233.

[25]Lauer, p. 285.

[26]C. E. Busby, "Regulation and Economic Expansion," The Yearbook of Agriculture; Water, 1955, The U. S. Department of Agriculture (Washington, D. C.: U. S. Government Printing Office).

Stream Classification

A second major allocation approach is that of classification of certain streams, or parts of streams, for particular use through the imposition of water quality standards. These techniques are relatively recent in development and tend to make allocation more sympathetic with the actual characteristics of water use. Two basic subtypes have developed: the river basin region classification, and the stream specialization, or parallel streams, technique.

River basin classification

River basin classification has developed in recent years largely in the Eastern United States as an approach used by some states in administering their water pollution control programs. As such, it is of course addressed only to considerations of water quality, not quantity. The states of North Carolina and New York have pioneered the development of the river basin classification system.[27]

Basic criteria.--This technique is based upon a study of the whole stream basin in order to determine the water quality which should be maintained along each part of the stream and its tributaries. The administrative agency employs an engineering staff who study the stream and determine its physical use potential. Public hearings are held to determine the types and quantity of stream use which will maximize the public interest. Standards for the various water quality characteristics are determined. These characteristics are grouped into various quality levels and a classification system established. These classification standards have generally been developed on a state-wide basis. They are often labelled "drinking water" (most restrictive), "bathing or swimming water," "fishing water," "irrigation," and "industrial" (least restrictive).[28] An inconsistency arises in that only a few characteristics such as organic

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[27] Harold H. Ellis, "Some Legal Aspects of Water Use in North Carolina," The Law of Water Allocation in the Eastern United States, ed. Haber and Bergan (New York: The Ronald Press Company, 1958), pp. 312-15.

[28] New York State Water Pollution Control Board, "Classification-Standards System," Legal Notice for hearings held April 11, 1956, p. 2.

load, can be applied throughout the classification scheme. For instance, the "highest" classification of drinking water may find completely acceptable relatively high concentrations of manganese. This same amount of manganese may be a highly unfavorable quality characteristic for an industry whose B.O.D. load relegates it to location along a "poor quality" stretch of the stream.[29]

A basic principle of the system is that no lower class waters will be allowed to flow into higher class waters (for instance industrial waters flowing into drinking waters of the major stream) if the result would violate quality standards. As a result, streams are frequently classified with strictest standards upstream and lessening further downstream. As flow generally is greater downstream, more total pollution may be permissible even under the same quality concentration standards.

After the stream has been classified, all users are required by an administrative agency to adjust their use characteristics in order to bring about the quality desired.[30] As a result, as water use demands increase, those users which have the most negative effects on water quality tend to seek lower classification areas.

By studying the total stream at once, this technique provides an opportunity for establishing a "public policy" with regard to the use of a stream. This policy, then, serves as a guide for potential users and as a basis for consistent allocation administration by the state agency so designated. Participation of the courts is limited to appeals from administrative decisions.

One potential problem of the classification approach is that it may tend to freeze existing patterns of water use to an unwarranted extent. There is insufficient evidence available, however, to justify any conclusions to this effect. On the basis of known information concerning North Carolina's program, the State Stream Sanitation Committee has been generally quite receptive to reclassification requests.

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[29] The widely varying requirements in terms of basic quality characteristics, which are common to industry types, were clearly pointed out in Chapter II. Only by maintaining a pure stream along its total length and dumping wastes elsewhere can this problem be effectively solved.

[30] Ellis, The Law of Water Allocation in the Eastern United States.

Stream Specialization

This technique was developed many years ago in Germany and has served well the needs of a highly developed urban-industrial area. Although it is feasible only in an area with a certain major drainage configuration, and requires a degree of planning and coordination uncommon in this country, it still presents substantial potential.

The "Emschergenossenschaft" (Emscher Water Board) was legislated into existence in the early 1900's.[31] Its birth was the result of the strains placed upon the water resources of the Ruhr area by a rapidly expanding heavy industrial complex. Over the years the population of the Ruhr area has grown to several million and industrialization has continued. Still this allocation technique has remained up to the challenge.

Basic criteria.--Under this technique, the administration of the water resources of the region is turned over to a "Genossenschaft" (cooperative association). Such an association may focus attention on one aspect of water resources--such as flood control--or may have jurisdiction over all aspects of water use.[32] There are two kinds of members: "associate," which includes municipal and rural public users, and "participants," who could be generally described as profit-oriented users.[33] Each member has voting strength in accordance with the size of the contribution which he makes to the association's expenditures.

The association employs a staff of experts which makes a comprehensive study of the region and particularly its water needs. A program is then developed for the most effective pattern of water use. The members of the association (all water users) share the cost of total

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31"The Legal Situation of the Emscher Water Board" (Unpublished manuscript obtained from Professor Daniel A. Okun, Head, Department of Environmental Sciences and Engineering, University of North Carolina, 1955).

32Allen V. Kneese, The Economics of Regional Water Quality Management (Washington, D. C.: Water Resource Program; Resources for the Future, Inc., January, 1963), p. 193.

33Gordon M. Fair, "West Germany: Water Pollution Abatement," Comparisons in Resource Management, ed. Henry Jarrett (Baltimore: Johns Hopkins Press, 1961), pp. 144-46.

water resource development according to the cost of their use to the system.[34]

Where the region is served by two or more rivers of significant size, it may be decided that the most efficient use of the water resources would be through specialization: concentrating all of the region's waste receiving and diluting load on one or more streams, while reserving separate streams capable of serving the same region for high quality water supply and water based recreation purposes. It is this situation which exists in the Ruhr Valley. Three major rivers serve the valley, all flowing from east to west, and lying generally parallel to each other. The Ruhr, and to a lesser extent the Lippe, are used primarily for water supply and recreation, while the Emscher is used for transportation and treatment of wastes.[35]

This specialization of streams may allow for significant savings in scale (such as a smaller number of plants with a larger, more efficient capacity) particularly in the treatment of waste materials. Research may be financed and special processes instituted for treatment of more complicated pollutants, which would be unfeasible, or at least extremely difficult, with a series of smaller plants located near each concentration of pollutors.

The success of this system probably requires that a public agency maintain ultimate control of all waters in the region and designate the most appropriate use for each.[36]

The system is most workable where the various streams are generally parallel and serve the region without excessive transmission distances and thus costs. It is also essential that water resource planning be coordinated with a total planning program for the region. For instance,

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[34]Richard Hazen, "German Works--Old and New," (A paper presented at the Annual Meeting of the Eastern Water Company Conference, Atlantic City, New Jersey, 1961), p. 4.

[35]Kneese, p. 199.

[36]A variant of this specialization approach is the recent proposal by the United States Secretary of Interior for the preservation of certain "wild rivers" in their natural state. In its present form the proposal contemplates public land acquisition as a means of control rather than regulatory action. (A bill providing for a national wild rivers system, SB 1446, passed the Senate in January 1966.)

if water based recreation is to be restricted by stream quality standards to only a few of the region's streams, then care must be taken that appropriate sites along the shore of these streams be developed and protected for this use. Otherwise, these sites will be pre-empted by private use.

Two elements of the stream specialization allocation framework should be emphasized here. The first is the basic concept of an association of users administering and financing development of a water resource. Presumably by committing each user to pay the cost to the total system of his particular water use, this technique works to eliminate external diseconomies or spill-over effects. The Ruhr Valley program has become known as the leading example of the "one firm" approach which internalizes the externalities inherent in the usual water pollution case where each firm is left to handle its own pollution problems. This solution, of course, is not without its own difficulties. By making voting rights roughly dependent on financial contribution, the technique places control in the hands of the large industrial users. Recreational and municipal uses could be at the mercy of this ruling group, as could smaller competing manufacturers.

The second major element is the stream specialization approach itself. Where a region can be served by two or more streams, the use of one for waste disposal and others for supply may be a highly efficient approach, both in terms of actual water development and in the compatibility of land use which would likely result. However, should it be applied to a region which is already heavily built up, its advantages might be seriously tempered by the mixed land use pattern and the excessive transportation costs which might result.

Market Control

The third basic allocation alternative places heavy dependence upon the market, with allocation based upon ability to pay. Economists have long urged that while economic efficiency, as it might be determined in a perfect market, does not perfectly reflect the public interest, it comes closer than any other available model. The two techniques discussed below reflect this thought. In the first--"Unregulated Market

Control"--the market is allowed to function freely. The second--"Public Market Intervention"--places a public agency in a position to intervene in the market process and to adjust what might be the economically most efficient pattern for any socially beneficial uses unable to compete in the market. Although these techniques have been rarely practiced, both have been the subject of sophisticated hypothetical testing by leading resource economists.

Unregulated market control

Water is only one of the total range of resources whose allocation is heavily regulated by the public institutions of our society. And it is safe to say that any drastic shift away from this regulation to a pure market control would be unrealistic. Still, it is valuable to examine the advantages and disadvantages which would be inherent in such a scheme.

Basic criteria.--A technique of unregulated market control would make the allocation of all aspects of water use entirely dependent upon the price system. When the market is working perfectly, all resources are being economically called to their best use.[37] Potential competing users are willing to pay only that price for a certain resource so as to achieve the maximum per unit satisfaction. Each decision unit attempts to adjust its consumption pattern so that the satisfaction per unit cost for all resources consumed is the same.[38] Among those with a potential water demand, the units of the resource use will go to those who derive the most satisfaction from them and, thus, are willing to pay the highest price.

Three characteristics of water use have been defined: quantity, quality, and ability to absorb wastes. The competitive framework for water quantity alone would be relatively straightforward. A certain number of gallons flow down the stream each day and these gallons could be bought and sold in the market; relative scarcity would determine price. When the factors of quality of supply and ability to absorb wastes are added, however, the situation becomes far more complex. The treatment of

[37] Hirshleifer, De Haven, p. 234.

[38] Fox, pp. 22-23.

wastes by upstream users (or lack of same) directly affects the quality of the supply received downstream.[39] If it is remembered that treatment of various pollutants involves similar processes--whether it be done by the potential pollutor before release into the stream or by downstream users in purifying their supply--then we may visualize how the unregulated market might operate.

If a plant (Plant A), as a result of its manufacturing process, released a waste which was high in manganese, then all downstream users would have to react to this change. A downstream pulp processer (Plant B) might find that it would cost him X dollars to treat his supply and eliminate the manganese waste. It would be beneficial then for him to pay the upstream pollutor anything up to X dollars in order to stop releasing the pollution. If the pollutor could change processes or treat the waste at a cost less than X dollars, he would accept the payment and cease to pollute the stream.[40] If his costs would be more, say Y, then he would continue to pollute unless Plant B met this price. If Y dollars were more than Plant B could afford, he would be forced to alter his operations.

Theoretically all potential users--public and private individuals, and groups--would compete for water use on equal ground in a free market. If the local municipality or any other user decided that a certain quantity of water was required for consumption, or that a reasonable stream quality was required for recreation, it would have to "outbid" other competing potential users. It may be argued that in this way the true relative value of all water uses could be empirically measured.[41]

There are several basic reasons why the unregulated market approach is seldom seriously considered as a solution for water allocation problems. The market as an allocating technqiue is dependent, for its effectiveness in utilizing water, upon the success which is achieved in communicating to all market participants all implications of their alternative choices, and the comprehension by them as to which of those

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[39]Otto Eckstein, Water Resource Development (Cambridge: Harvard University Press, 1958), pp. 60-65.

[40]Kneese, pp. 51-54.

[41]Maass, et al., pp. 40-41.

choices will be in their best interest. With the increasing complexity of the urban-economic structure, it is becoming less and less likely that this communication and comprehension will occur.

Also, a basic weakness with this technique is the tenuous nature of one of its underlying assumptions, that the most efficient distribution of resource use from an economic standpoint necessarily results in maximization of the public interest in a particular area or drainage basin. An industrial concern may well find that its profit is maximized by locating in a particular area and purchasing large quantities of water use. The number of employees required for this highly automated concern, however, may be small and the profits may flow almost entirely to stockholders who are already in the higher income brackets and, in addition, live outside the particular drainage basin. Other users, although able to pay less for water use, may contribute far more to the well-being of the community. Considerations such as this--magnified by imperfect competition and other such factors which flaw the laissez faire analysis--make it rather unlikely that an unregulated market in fact will produce optimal results in the water resource economy.

In addition, public uses, such as domestic and aesthetic-recreational, might find it difficult to compete economically for the water resource use we have come to feel is necessary. Additional revenue sources, perhaps including increased taxes on water using industries, would be required to make the public interest economically competitive.

Public market intervention

Rapid urbanization and its inherent complexity have required that the administration of more and more aspects of our society be delegated to experts. The "public market intervention" technique extends this practice to the allocation of water resources. The action of the market remains the central element, but efforts are made to improve the effectiveness of the market through public intervention.

Basic criteria.--In the case of "public market intervention" a public agency with delegated functions applies its expertise to guide

water allocation.[42] Through this technique the total capacity of the water resource is technically defined into interrelated units of use: quality, quantity, and ability to absorb wastes. The user then pays a price for the quantity taken in; the price dependent upon the quality characteristics of the water as received. He pays a second charge based upon the net effect of his use upon the resource. He is, in effect, renting the water and has the normal renter's responsibility of paying for any decrease in value, such as diminishing quantity or quality.[43] If his action improves the quality, then he receives payment for the value of the improvement.

Pricing would be determined by a public agency and would be dependent primarily upon relative scarcity of the water use characteristic involved. If, for example, Plant A were to locate on a stream and, through its use of the water, add a substantial amount of manganese content (as in the previous example), thus providing a definite benefit to the quality of fishing--both commercial and recreational--in a previously mineral-poor stream (no effect on any other use), then it would be in a favorable position. As A's use of the water improved the quality (in terms of competing demand) and did not change the quantity, A would be entitled to a payment for its water use.

Say, then, that Plant B located upstream from Plant A and, as the result of its pulp manufacturing process, released a glucose waste, which inhibits spawning of fish and reduces the value of the stream for fishing purposes. The effect of this upstream activity on Plant A's position would be that the value of manganese would drop on the publicly determined market because no substantial fish population existed to benefit from its presence. The manganese released would then neither improve nor impair water quality and no money would change hands due to downstream water quality effects. The plant would continue to pay for its supply but at a lesser rate because quality has been decreased by the upstream polluter.

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[42] M. Mason Gaffney, Professor of Agricultural Economics, University of Missouri, "Comparison of Market Pricing and other Means of Allocating Water Resources," an address delivered before the Southeastern Water Law Conference (Athens: November 9, 1961), p. 4.

[43] Hirshleifer, p. 235.

Plant C then locates downstream and begins the manufacture of textiles. Plant A's supply costs remain the same, as no upstream change has occurred. The cost of the water resource system of Plant A's manganese release has become substantially greater because the process Plant C intends to use for the textiles has a very low manganese tolerance level. As a result, Plant A's water depreciation costs are high and Plant C's water supply costs (charges to administrative agency) are quite low because of its low use to them as received.

Plant A can, of course, manipulate its charges by improving its waste treatment facilities. Perhaps reclaiming the manganese and selling it will be most profitable, when compared with high charges for depreciating water quality.

Public water needs--for domestic and aesthetic-recreational use--would be determined by a legislative body aided by expert analysis. These needs could be imposed as basic regulatory guidelines for allocation of the stream. The costs, which their use would create for private users, would then be accepted as "given." On the other hand, public uses could be assessed the same unit charge as other users. It would be valuable for public uses to be considered on an equal basis with private uses, not only for this technique of allocation to work efficiently, but also for the public to have a clearer picture of the actual cost of recreation.

The need for some form of user charges to help defray joint costs of water resource developments has been noted by the Federal Power Commission in its administration of the hydroelectric licensing provisions of the Federal Power Act. The question has arisen in this context: suppose that an FPC licensee is approached for permission to divert water from a licensed project reservoir for a non-project purpose, such as a city water supply. Should the diversion be permitted, with or without charge, if it will result in some loss of power generating capacity from the project?

The Commission has taken the position in this situation that the integrity of a project should be preserved by a charge to reimburse the licensee for any substantial loss of power values. Thus far, this view has been applied only indirectly through accounting adjustments on the

licensee's books reflecting the effect on project earnings.[44]

Recently the Commission has taken a further step toward implementing its position on user charges by instituting a policy of inserting a special license condition in future licenses which would establish a regular procedure for obtaining permission to make joint use of licensed project reservoirs.[45] The rule specifically mentions water supply for pumped storage, hydroelectric, steam electric, irrigation, industrial, and municipal uses among the purposes that may be the subject of an application. It provides that the licensee must permit reasonable use of his project or a water supply for any such purpose ordered by the Commission, with mutually agreeable compensation arrangements approved by the Commission. If the parties cannot agree, the Commission may fix the compensation itself after a hearing. The compensation provisions would not relieve a licensee from any license requirement obligating him to operate the project in the public interest without charge. While these special license conditions will apply only to future licenses, the Commission has indicated it would handle joint use problems affecting outstanding licenses on an ad hoc basis.

The Federal government has a selfish interest in requiring user charges because of the recapture clause of the Federal Power Act (Section 14). Under this provision the United States may take over a licensed

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[44] In at least two formal orders the Commission has authorized the licensee itself to divert water from a project reservoir for steam plant cooling water use and required that appropriate credit be made to annual project earnings on the licensee's books as compensation for loss of hydroelectric generation. Duke Power Company, Project No. 2232, 26 FPC Reports 552 (1961); South Carolina Electric and Gas Company, Project No. 516, 15 FPC Reports 1544 (1956). An earlier Commission decision authorized a similar diversion for the license term only, reserving the right to make further orders if found appropriate. Public Service Company of New Hampshire, Project No. 1893, 8 FPC Reports 853 (1949).

The Commission has also taken informal action in other cases involving municipal water supplies indicating it had no objection to diversions provided compensation arrangements were made.

[45] This policy was adopted April 7, 1965, and the Commission simultaneously terminated a pending rule-making proceeding which would have adopted the same procedures as a general rule, R-249.

project when its license expires, on payment of the licensee's net investment plus any severance damages. In calculating the net investment, an amortization reserve computed under Section 10(d) of the Act is deducted from the value of the project. This reserve is made up of surplus project earnings in excess of a reasonable rate of return on earnings after the first 20 years of project operation. The surplus earnings, of course, are dependent on total earnings. Thus, when power generating values are impaired by a diversion from a project reservoir, the surplus earnings are reduced. This in turn raises the net investment which must be repaid by the United States upon recapture.

The FPC has not announced any approved or favored method of calculating the compensation for loss of hydroelectric generation resulting from diversions for other purposes, but there are at least two methods of computing such values which might be used. It is valuable that they be considered here in terms of their potential general application in the field of water use allocation.

The first approach is commonly known as the "Project Cost Method." The point of departure for the Project Cost Method is that a hydroelectric power project costs a given amount to utilize a guaranteed quantity of water for power generation. If the water supply is reduced, the resulting power loss is directly proportionate to the reduction in water supply. By relating this loss to the annual value of the project, one obtains a dollar figure representing the annual economic loss in power.[46]

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[46] A simplified illustration of the Project-Cost Method:

Assume a project, constructed for $50,000,000 at a point on a river with an average stream flow of 10,000 cfs. Assume further a proposed diversion of 10 cfs, or 0.1% of the total average flow. The annual value of the project can be approximated by applying a typical fixed charge rate of, let us say, 15% to the $50,000,000 total value, for an annual value of 7.5 million dollars. Applying the percentage of lost stream flow, the resulting annual power value lost is $7,500.

While this simplified example suggests the principal relationship involved, some points are neglected which are sometimes important, e.g., the fact that low-water flows may be much more important in determining power value than high flows, which may not be fully usable. Due attention should be given to variations in flows, and in the diversion, degree of storage regulation, and the effect of these factors on the usefulness and value of various portions of the flow.

The second approach is commonly known as the "Value of Power Method." Under the Value of Power approach, power losses are evaluated on the basis of the cheapest alternative method of producing the power. In the case of a hydroelectric plant, the cheapest alternative will ordinarily be steam-electric generation. After capacity and energy values are determined for the alternative steam-electric installation, these values are then applied to the hydroelectric capacity and energy losses to obtain the total power value lost.[47]

These are rough measures of the cost in terms of power generation values from diversions for non-power uses. Ideally, the two approaches might be applied in tandem, each serving as a check on the other. From a combination of such computations, one might hope to obtain at least a "ball-park" figure representing the probable order of costs involved. In some cases, however, the complexities of actual computations may, as a practical matter, rule out the use of one method or the other.

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[47]A simplified illustration of the Value of Power Method:

Assume a hydroelectric project that utilizes a 200-foot head, equivalent to 15 kw of power capacity per cfs of stream flow. (A 100-foot head under average conditions produces approximately 7 to 8 kilowatts of power capacity per cubic foot of stream flow.) Assuming a proposed diversion of 10 cfs, the average power production lost from this project would be 150 kw. Multiplied by the number of hours in a year, this would be about 1.3 million kwh annually. If an appropriate load factor is 50%, the loss of capacity would be 300 kw. If the assumed capacity and energy values for alternative steam generation are respectively $20 per kw and 3 mills per kwh, the loss of power values at 50% load factor could be calculated as follows:

Capacity loss - $20 X 300 = $6,000
Energy loss - 1,300,000 X $.003 = $3,900
Total loss - $9,900 per year

As in the previous example (footnote 46), only the basic principles are suggested here. Among the refinements that may need to be considered, one that could affect the computation materially is an appraisal of the proper load factor to apply in computing the loss of capacity. If the plant is designed to use an entire day's stream flow during a few hours of peak load at a load factor of say 20% (and the diversion of water would prevent full use of the plant in that way), the capacity value would be 2 1/2 times as large as in the example. If the plant is in fact "under-installed," so that it cannot concentrate even the low-water flows in the hours of heavy loads that determine capacity needs, there might be little or no capacity loss.

The potential application of these evaluation techniqes to a broader range of water resource allocation problems merits exploring. Thus, similar tools might be fashioned to measure the cost of irrigation or industrial water supply withdrawals from a municipal reservoir, or the cost of municipal water supply diversions from a reservoir used primarily for recreation, or the cost of holding water in storage to benefit recreational use in preference to releasing water from storage for its originally intended use of diluting downstream sewage and wastes. If a wide range of techniques could be developed for everyday use, it should be possible to readily convert almost any potential water use alternatives into monetary values.

North Carolina Water Law

Water allocation as it has developed in North Carolina points up two considerations to be kept in mind in evaluating subsequent sections of this study. First, the various techniques have been discussed here only in a general sense in an attempt to identify the principles or allocation criteria on which they are based. Through legislative enactment and judicial interpretation, each state has evolved its own variations. And second, the techniques as applied are not mutually exclusive and, in fact, are often applied in combination.

In several states a combined appropriation-riparian system has developed. North Carolina water allocation law, however, embodies a combination of riparian tenets and the stream classification approach for water quality control. As a riparian rights jurisdiction, it has embraced the reasonable use modification and has applied the balance of convenience test in refusing to enjoin publicly beneficial water uses. There are indications that its courts would apply the concept of prescriptive rights to sustain long continued adverse uses of surface waters. There are also indications that while injunctive relief may be available against improper sewage and waste disposal practices by public agencies, the North Carolina courts would probably not enjoin a public water supply from operating because of technical violations of the rights of downstream riparian owners. In any event, there is no evidence of a case in which a permanent injunction has been granted against a public water supply in North Carolina.

North Carolina was a pioneer in the development of the river basin region classification technique, and its application in this state differs little from the model described above. What is significant is the success to which the two techniques (riparian and basin classification) have been coordinated.

Many riparian owners in North Carolina have apparently chosen, for various reasons, to "sleep on their rights." In instituting the classification sytem, the State is saying, in effect, that while the individual riparian maintains the right to take legal action in protection of his private rights, the maintenance of stream quality is also very much an issue of the public interest, and that water use, as a result, must be regulated as a matter of public policy.

Summary of Techniques

The six techniques discussed in this section encompass the range of contemporary allocation thought. Each is briefly summarized below.

I. The first major type of approach is that of traditional water rights law as it has been set down in the United States. This allocation law has been based upon two doctrines: the riparian doctrine in the states east of the Mississippi River and the prior appropriation doctrine in the seventeen states west.

1. Riparian Doctrine provides generally that the owners of land which adjoins a natural watercourse have a right to the use of its waters in unlimited quantities for domestic purposes, and to "reasonable uses" for other purposes on riparian land. "Riparian lands" are those which directly adjoin the watercourse itself, and use of water is limited to these and none other. The use of water to supply a municipal system would not be allowed under strict riparian interpretation. Allocation here is dependent upon the ownership of land adjoining the watercourse.

2. Appropriation Doctrine provides that rights arise from the application of previously appropriated water to a beneficial use. This approach was developed during the gold rush days in the west and closely resembles the staking of a claim, whereby the first person to file a claim for a particular quantity of water obtains permanent

rights to its use. This owner must continue to use the water for a beneficial use. Allocation here, then, is based upon chronological priority of application for a beneficial use.

II. The second type of approach is based upon a comprehensive study of the stream or streams involved for water quality management and a public determination of their use.

1. River Basin Classification is based upon a comprehensive study of each stream basin in order to determine the water quality which should be maintained along each part of the stream. This quality would be measured by the concentration of pollutants resulting in the stream after particular withdrawals or effluent deposit. The State of North Carolina has pioneered in the development of this approach. Allocation here is based on the ability to make specific use of water consistent with quality limitations along a particular length of stream.

2. Stream Specialization involves a study of the water needs of the total economic region, based upon existing use and development potential. Certain streams are then assigned to receive wastes and other streams capable of serving the same region are preserved for water supply, recreation, and aesthetics. Allocation is based here upon specific use consistent with water quality standards established for an entire stream.

III. The third type of approach bases allocation upon price and ability to pay as determined by the market.

1. Unregulated Market Control places the use of surface water resources completely at the disposal of the market. Allocation here then is dependent upon economic position and ability to compete in the market.

2. Public Market Intervention involves the regulation of the use of a stream by a public agency attempting to maximize the public interest. With market guidance, the economically most efficient pattern of use is determined, and then adjusted where required by the public interest. Allocation is dependent upon expert determination of the pattern of use which maximized the public interest.

CHAPTER III

LAND USE IMPLICATIONS

This chapter examines the hypothetical land use implications of each of the water allocation techniques described in Chapter II. They are hypothetical in the sense that 1) they cannot be observed in life but rather must be hypothesized, and 2) a series of assumptions must be made which work to hold constant other factors that normally influence land use patterns. The approach taken is to first define the nature of the land use variable and then to project the land use impact of each of the previously defined techniques.

The Land Use Variable

Land use implications will be measured in terms of four basic characteristics: density, form, composition of use, and composition of social class.

Density of development

Density is the relative concentration of human beings and their activities across the land. It is computed as the number of people per unit of built up land area. Residential densities vary widely from well over 700 persons per acre in the heart of large urban areas to less than one person per acre at the urban fringe. High density living requires an exceedingly high level of public facilities and services. Where these are not provided, the structural and environmental conditions quickly deteriorate.[1] On the other hand, when adequate facilities are provided, high density living appeals to even the upper income groups.

Density also largely controls the level of human interaction: when large numbers of people live in a relatively limited land area, the number of contacts the average person has with persons outside his nuclear family is much greater than if he lived in a low density development.

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[1] Martin Meyerson, Barbara Terrett, and William L. C. Wheaton, "Housing and Community Development," Housing, People and Cities (New York: McGraw-Hill Book Company, Inc., 1962), pp. 4-9.

Density has additional significance in terms of land values. When a combination of forces causes people to live at high density, the value of the land is maintained at a very high level. The owner of the land stands in the position to reap an abnormally large return.[2]

Thus, when an allocation technique tends to move density to a high or low level, the social, economic, fiscal, and physiological implications are great.

Shape of development

The shape of development, as used here, means the physical form of urban land uses. This form may be a linear, continuous strip (perhaps along and on both sides of a surface stream); a series of small, independent developments, separated by non-urban land, or one large urban mass. At the non-urban extreme, the population could live in an almost formless distribution of land uses equally across the land. These varying forms have inherent in them sharp differences in densities, revealing the close relationship between these two land use factors.

The form of urban and non-urban development has significant implications for the living patterns of the population. Accessibility--the speed and convenience of moving from place to place--is a highly important variable. Time spent traveling to work, to school, to shop, and to socialize is often an unproductive time gap in today's busy schedules. The form which traditionally provides maximum accessibility is the circle with the most heavily used facilities naturally developing near the center and served by a system of major radial accessways.[3] The larger the circular mass, the greater the number of possible destinations within reach (density and congestion held constant). The linear form, if developed at the same density, would have poorer accessibility as there would be little opportunity for centrality of facilities. The scattered, more evenly distributed growth pattern would have the poorest accessibility of all because of the relative distances between individual users (density).

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[2]Meyerson, Terrett, and Wheaton, "Municipal Programs for Urban Development," ibid., pp. 304-309.

[3]Richard D. Ratcliff, "The Dynamics of Efficiency in the Locational Distribution of Urban Activities," Readings in Urban Geography, ed. Harold Mayer and Clyde Kohn (Chicago: University of Chicago Press, 1959), pp. 303-305.

The form of development also has important implications in terms of exposure to open space. It is generally agreed that while city dwellers enjoy the heavily built-up nature of a large urban area, their emotional well-being requires that they have ready access to large areas of non-urban land use.[4] The large, concentric growth form makes the trip to the country a long and congested one for the large share of the population living within the urban mass. This is less true for the series of smaller concentric developments separated by open space. The linear development pattern has even better access to open space. As related to a surface water resource, the linear development form would be a relatively narrow strip of urban development along one or both sides of the stream. Residents by traveling a short distance in a direction perpendicular to the stream would reach either the open space of the stream itself, or in the opposite direction, the non-urban hinterland. The dispersed form would, of course, provide maximum exposure to open space as there would be in a sense no urban development at all.

Community and individual identity is closely related to form.[5] The separate concentric development, either large or small, carries with it a community identity. As it grows in size, however, individual identity begins to fade and political sub-communities emerge to take their place. Community identity would be even more cloudy in the continuous linear development form. We see this submergence of individual community identity in the growth of the eastern megalopolis, where we hear more and more of the eastern seaboard complex and less of the individual urban developments which make it up.[6] In a sense, the dispersed form would maximize individual identity, while almost completely eliminating that at the community level.

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[4] Marion Clawson, "A Positive Approach to Open Space Preservation," Journal of the American Institute of Planners, XXVIII, Number 2 (May, 1962), pp. 124-25.

[5] Gordon Cullen, Townscape (New York: Reinhold Publishing Corporation, 1961), pp. 9-11.

[6] Jean Gottmann, Megalopolis (New York: The Twentieth Century Fund, 1961), pp. 3-11.

Composition of use

Human activity and its relationship to water has been discussed here in terms of land use. There are many distinct uses of land, but they may be classified for our purposes here as: commercial, residential, industrial, recreational, and agricultural. The juxtaposition of these uses determines composition. The composition is heterogeneous when there are a variety of use types located together and homogeneous when like uses congregate.

Advantages have been claimed for both the homogeneous and heterogeneous use patterns. Lewis Mumford, in The Culture of Cities, established the value of a diverse use pattern.[7] He feels that the mixed use pattern encourages a close relationship between a family and the "neighborhood mechanic, barber and shopkeeper, which is impossible if these uses are congregated in large service and shopping districts." Children gain particular value from a mixed use pattern, and "the walk to school should provide the maximum in variety of visual experience, and thus be an important part of the education."[8]

Many experts in the location and interrelationship of urban land uses see problems in a mixed or heterogeneous use pattern. Each use type has special needs and special performance characteristics. The differing needs for, and effect on, a surface water resource would be a typical example. Traffic generation, noise, hours of operation, building size, and visual impact are others. When there is incompatibility among use types, property values and structural conditions are apt to decline and the residential environment which results is not wholesome.[9]

Composition of social class

In the same sense that uses may be either homogeneously or heterogeneously arrayed, socio-economic classes may locate in a separate or

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[7] Lewis Mumford, The Culture of Cities (New York: Harcourt Brace and Co., 1938), pp. 460-72.

[8] Lewis Mumford, "The Neighborhood and the Neighborhood Unit," Town Planning Review (Periodical, 1954), XXIV, pp. 267-68.

[9] Clarence S. Stein, Toward New Towns for America (New York: Reinhold Publishing Company, 1957), pp. 218-22.

mixed pattern. Warner and others have found that the stratification system of most urban areas is composed of five classes: upper, upper middle, lower middle, working, and lower.[10] Present income is the dominant determining factor, although tenure and reputation in the community are also considered.

Heterogeneity of class has the advantages of providing greater understanding through more direct interaction between diverse elements (racial, religious, ethnic, etc.), broadening the educational process, and providing the leadership element often lacking from homogeneous lower class neighborhoods.[11]

There is also more even distribution of tax revenue when residential communities are socially heterogeneous, and this is important in terms of the level of educational and other services which can be provided.

Those supporting homogeneous class development, on the other hand, claim that without similarity of background and interests, the forced interaction brought about by heterogeneous living patterns will lead to conflict rather than understanding.[12] They further claim that the raising of lower and working class standards through exposure to higher economic and social goals must be balanced against the leveling effect on the higher class occupants--especially children. What is most desirable, they feel, is a generally homogeneous class composition which allows for positive relationships among occupants.

Evaluation of Allocation Techniques

From the above discussion it is clear that differences in density, form, composition of use, and composition of social class have considerable importance for living patterns. Two other questions will be analyzed in this section: first, to what degree does the availability of surface

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[10] R. Kornbauser, "The Warner Approach to Social Stratification," Social Mobility in Industrial Society (Berkeley: University of California Press, 1962), pp. 224-28.

[11] Herbert J. Gans, "The Balanced Community," The Journal of the American Institute of Planners, XXVII, Number 3, Part 1 (August, 1961), pp. 177-78.

[12] Ibid., p. 176.

water control land use patterns, and second, what implications does each of the six previously defined techniques have for living patterns, in terms of the four variables discussed.

Surface Water as a Land Use Determinant

There are a variety of factors influencing land use patterns; water resource availability is just one. Among the many others are: locational pattern of employment, highways and other transportation available, as well as quality and characteristics of the land itself. This study does not attempt to measure the relative importance of water as compared with these other locational factors, but rather to hold other factors constant, and to hypothetically isolate the land use patterns which would emerge if the surface water allocation technique were the only operating land use determinant. With this goal in mind, the following assumptions were made:

1) Scarcity of water--It will be assumed that the hypothetical region suffers from an economic shortage of water resources which makes this locational factor dominant over all others.

2) Existing growth--It will further be assumed that there is no substantial amount of land use development at the time a water allocation process is applied, which is inconsistent with the forces to be exerted by it.

3) Transmission costs--And finally, it is necessary to assume that transmission costs are relatively high. This means that individual users tend to either locate close to a stream or, if further away, to live in larger developments where the greater transmission costs are divided among a larger number of people.

Riparian doctrine

The strict riparian doctrine ties allocation directly to the land; the basic principle being that all water taken from a stream must be used on land immediately adjacent to it. Such a doctrine strictly enforced greatly restricts the developable land and strongly influences the resulting land use pattern.

The land use shape is linear--following the course of the stream--and made up mainly of the riparian tier of parcels, with perhaps a second tier of supporting uses, whose occupants would go to the riparian's land to fulfill their water needs.

With developable land so limited, the density of development would necessarily be very high in the riparian tier. Development in the secondary dependent tier would be much less dense, and that in the hinterland would be very low with individual homesteads spread across the land dependent on ground water for existence.

The composition of use would tend to be heterogeneous as heavy water-using industries (which normally make heaviest use of the stream and can bid highest for its use) would be dispersed at various points along the entire length of the stream, in order to benefit from the rejuvenation which might occur as discussed in Section II. Residential developments and commercial uses that would serve them would be interspersed between the industrial clusters.

The composition of social class would, in contrast, likely be homogeneous. As noted all land use densities would be quite high relative to what we know today. In order to economically compete for riparian land, low income groups would necessarily have to live at extremely high densities.[13] In higher income areas, densities could be lower because each family would be able to pay more for its share of the scarce land.

Prior appropriation

This technique results in the assignment of permanent rights to a specific quantity of water to the first person who puts it to a beneficial use. There is no requirement that it be used on riparian land.

When applied to an undeveloped area, this technique has commonly resulted in monopolization of water rights by agricultural uses. This has probably occurred because these uses were the first to settle on the area, and because the states in ranking priorities among beneficial uses have given irrigation a preferred position.

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[13] Ralph Lazarus, "Classville, U.S.A.," an address before the Better Business Bureau of Metropolitan New York, October, 1962, pp. 7-9.

In more recent years values have changed. If the appropriation technique were applied to an undeveloped area with competing use demands, the State could play a vital role in determining which uses were most beneficial and in determining use patterns. With the current decline in agricultural dominance, it is quite possible that the industrial-urban uses would have priority with regard to water rights. The stability which characterizes appropriation would suggest that the pattern of uses originally established (based on the nature of the technological and economic thinking that prevailed at the time the technique was instituted) would become the permanent pattern of uses.

Appropriation would provide substantially greater freedom of location with relationship to the stream. The form of development would likely be one of a few large urban masses. This would be true largely because in competing for water, the existing major urban center would likely have priority over new developments proposed. The density of development would be roughly the same as presently exists in major urban areas.

Composition of use here might be quite homogeneous. Each urban unit, once its total appropriation was set, would have to divide as a matter of policy the uses to which it would allocate its water supply. While it is possible that a balanced pattern would be sought, it is more likely that the economically most intensive uses of water would be favored, presumably industry. Residential uses outside the urban mass would tend, then, to assume a dispersed pattern such as that described for riparian law, with low density and private or small unit water facilities. Composition of social class would be relatively unaffected by this technique.

River basin region classification

River basin classification would strongly affect land use patterns. The tendency has been to require that the highest quality of water be maintained near the source of the stream, with progressively lesser restrictions as one moves downstream. As the quality to be maintained influences greatly the uses which can most economically locate at a given place along the stream, a homogeneous use composition could be expected. Industrial uses having the heaviest potential waste load would tend to

locate downstream where quality standards are lowest. Under these conditions they might be expected to agglomerate substantially more than at present. Non-supervisory workers would seek residential locations immediately upstream from their work locations, as they now do. The commercial concerns that serve them would locate here also.

The premium residential locations would be on the upper portion of the stream where the aesthetic and recreational potential was greatest and the competition from "undesirable" uses was least. With the high degree of efficiency which exists in communications today, supervisory and controlling families might well seek these more premium locations. The business establishments which serve them would likely locate nearby. Thus, a high degree of homogeneity of <u>social class</u>, as well as use, could be expected.

In terms of <u>density</u>, the probable effect would be that while density within particular social class residential areas would not change, these areas of differing density would be more clearly separated. The shape of development would not be greatly influenced.

<u>Stream specialization</u>

This technique by designating some streams for waste disposal and others for water supply would tend to encourage <u>homogeneity of use and class</u>, as would the river basin approach. The streams which were designated to receive wastes could be expected to attract industry. Workers here would also tend to locate close to their work. However, residential development would tend to occur further from the stream because of its aesthetic drawbacks.

The high quality supply streams would be depended upon by the region for aesthetic and recreational use. The upper classes, advantaged by economic position as well as efficient transportation and communication, would tend to locate here and their business servants would follow <u>Densities</u> in these high quality areas would be low both because of their better financial position and because waste disposal into the stream might be restricted, requiring large assimilation areas for individual units. The form of development here would tend to take a linear pattern as industries and other users sought locations all along the stream in order to maximize use.

Unregulated market control

This technique would give the economically most efficient user of water (that user able to pay the highest unit price) the right to its use. This would seem upon first analysis to give the dominant position to industrial uses. It may pose some difficulties for municipal institutions to establish the value of water use to their citizens, but they would certainly have to become successful participants in the market in order to satisfy the physiological needs of their people. Recent studies by Wollman indicate that under certain circumstances recreation can compete successfully as an economic user of water.[14] With the ever increasing demand for water recreation, and faced with a pure market allocation framework, total recreation demand would necessarily be framed in economic terms.

The composition of use would likely be heterogeneous with industries locating up and down the stream interspersed with low income worker housing. Higher income housing would develop away from these areas and a homogeneous social class composition would result. The pattern of both use and class would closely resemble that which exists today. The shape and density of development would not be strongly influenced.

Regulated market

The regulated market system, as we have described it, would give to legislatively guided experts a major potential role in land use decisions. It is idle to speculate on the land use patterns likely to emerge. Many variables which cannot be established in advance would affect the ultimate land use patterns. For example, a decision that acute unemployment required assigning water allocation priority to industrial uses might well mean that prestige residential areas, to the extent that they were dependent on water, would not exist and that water based recreation would be minimal.

Summary of land use implications

Each of the allocation techniques then has differing hypothetical

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[14] Allen V. Kneese, "Some Economic Effects of Water Use Patterns in New Mexico," paper presented at the Western Water Resources Conference, 1960.

land use implications in terms of the four pattern variables. Some of the techniques will not appreciably affect certain of the variables and this is in a real sense as significant to a choice among them as the case where a strong influence is exerted.

Projected here with other forces held constant, the strict riparian doctrine would seem likely to result in high density, linear development with some tendency toward heterogeneity of use. Prior appropriation would result in stability in the land use pattern, and one large rather than several smaller urban concentrations. Composition of use could be quite homogeneous. River basin region classification would tend toward homogeneity of use and class, with cluster shaped developments. Stream specialization would also result in homogeneity of use and class. Growth would tend toward a linear pattern.

With unregulated market control would come homogeneity of use and heterogeneity of class. Public market intervention would have definite land use implications, but these would be determined by the action of the market and by public policy decision, working within the allocation framework, and are difficult to predict.

CHAPTER IV

CONCLUDING OBSERVATIONS

The stated purpose of this study was twofold: First to test the importance of the water resource allocation technique as a land use determinant, and second, to provide a firm foundation for further research in this field.

Although this study has only scratched the surface of the research needed to make water allocation an effective land use planning tool (or vice versa), certain conclusions can be drawn.

First, the rapid growth and urbanization of the population generates a total demand for water in some areas which is greater than the available supply. When this occurs techniques must be developed for allocating the available water resource use (in terms of quality) quantity, and the ability to absorb wastes, among the various land uses.

Secondly, as more and more areas have recognized the need for an effective allocation framework, research in the field has been stepped up. The views of these researchers can be synthesized into six allocation techniques, each with its advantages and disadvantages.

Thirdly, although the land use implications of these techniques have been given little attention in prior research, analysis here indicates that they are potentially very important.

With all other development factors held constant, the various allocation techniques would result in drastically different land use patterns. Evidence of these expected impacts in existing land use patterns was difficult to identify, however. This was true both because the techniques as described in the study have seldom, if ever, been applied in pure form, and because water resource availability in the real world is only one of a large number of locational factors.

Thus, while the study was able to identify certain land use implications inherent in the allocation techniques, it was not able in any meaningful way to measure their relative strength. That is to say, if an economic region or parallel rivers approach was applied in a strict manner, would all or even most industries with heavy waste loads locate close to the stream designated for waste disposal? Or, would they rather

consider access to a major highway network or an existing urban-industrial concentration as more important than the added waste transmission costs? Each firm would be faced with this same question and their answers would likely vary, based upon the relative importance of water in their total production process. The question remains, then, as to the actual strength of the impact of any given scheme of water resource allocation, and further research in this area would seem justified.

Finally, this study points to the need for participation of the regional land use planner in the allocation analysis. His role focuses on the bringing together of technical physical development studies with the political decision making process, and thus clearly structuring the allocation decision. The physical development considerations, which are the particular concern of this profession, are basic to the allocation issue.

This close relationship makes it essential that regional planning studies be broadened to include evaluation of the existing allocation system, and the testing of promising alternatives. As water shortages will soon exist in many regions of the country, it is essential that these studies begin now and be continued--allowing them to become a permanent part of the planning process.

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